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Continuous Physiological Monitoring of Ambulatory Patients

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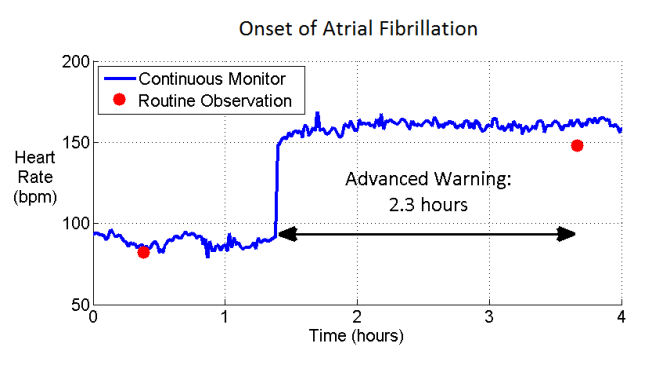
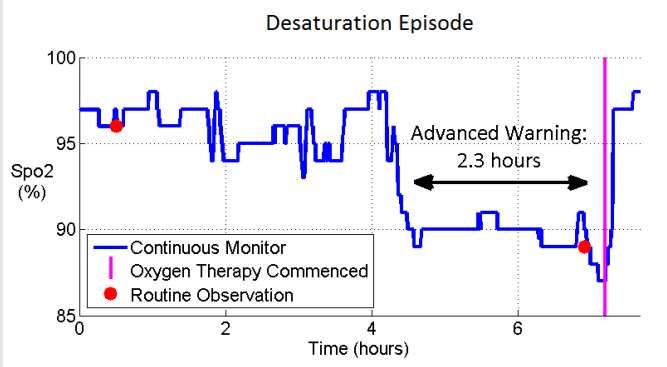




Using wireless sensors for earlier detection of physiological derangements than routine observations.

For what proportion of patient stay can continuous ECG and pulse oximetry data be captured using wireless sensors?

222 patients were monitored wirelessly during their recovery from cardiac surgery on a general ward. ECG data were acquired for the majority of patient stay, whereas pulse oximetry data were acquired for less than a fifth of the time. Furthermore, over a third of patients requested to stop wearing sensors. Therefore, there is room for improvement to the design of wireless sensors, particularly the pulse oximetry component.

Ambulatory patients are monitored intermittently

Clinical deteriorations of hospital patients must be recognised early to maintain patient safety and minimise treatment costs. Routine practice on UK wards is to measure physiological parameters intermittently every 4-6 hours to aid recognition of deteriorations. Thus there may be a prolonged period of deterioration prior to recognition.

Deteriorations may be detected earlier by continuous monitoring

Wireless sensors, combined with risk prediction algorithms, may enable earlier detection of deteriorations by continuously monitoring physiology. However, such systems depend on reliable data acquisition. We assessed the proportion of patient stay for which continuous ECG and pulse oximetry data could be captured using wireless sensors.

Patients' tolerance of wireless sensors is unknown

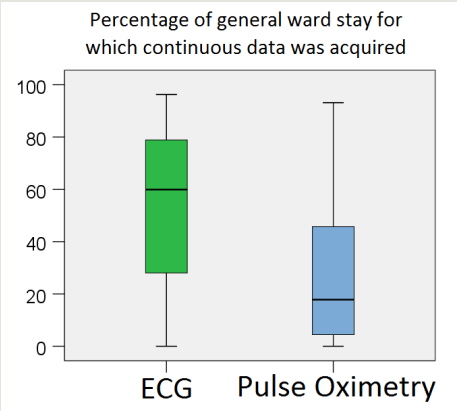
In a previous assessment of patients' tolerance of wireless sensors, none acquired data consistently for 24 hours [1]. Therefore, wireless sensors which are routinely used in the NHS were chosen for this study. Whilst more cumbersome than state-of-the-art sensors, they may be more reliable.

Method

A post-surgical cardiac ward was equipped with wireless sensors which transmitted data to a central monitor in real time. 222 patients consented to wear a sensor whilst recovering from cardiac surgery.

Results

196 patients wore a sensor (22 did not stay on the ward, 3 requested not to wear a sensor, and 1 was not given a sensor for clinical reasons). **122 wore a sensor until discharge**, 66 requested to stop wearing the sensor early, 6 had the sensor removed for clinical reasons, and 2 were transferred elsewhere. The median length of ward stay was 4.5 days. The 196 patients wore sensors for 898 out of 1344 days. **ECG and pulse oximetry data were acquired from each patient for 62% (52) and 18% (41) of their stay respectively.**



Conclusions

ECG data were acquired for the majority of patient stay, whereas pulse oximetry data were acquired for less than a fifth of the time. Furthermore, over a third of patients requested to stop wearing sensors. Therefore, there is room for improvement to the design of wireless sensors, particularly the pulse oximetry component.

Future Work

This trial aims to determine the proportion of physiological derangements detected by wireless sensors over an hour before standard monitoring. Two examples are shown above.

The dataset will also be used to design risk prediction algorithms.

References

[1] Bonnici T *et al.* Testing of wearable monitors in a real-world hospital environment: what lessons can be learnt? In *Ninth international conference on wearable and implantable body sensor networks, 2012*. Washington DC: IEEE, 2012; 79–84.

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